

Remarks

Claims 1-35 are pending in the application. Applicants thank the Examiner for acknowledging the allowability of claims 4-5, 7-8, 16-17, 19-20 and 32.

Rejections of claims 1-3, 6, 9-15, 18, 21-31 and 33-35 under 35 U.S.C. 102(b)

Claims 1-3, 6, 9-15, 18, 21-31 and 33-35 were rejected under 35 U.S.C. 102(b) as being anticipated by Bakker¹. Applicants respectfully traverse these rejections with slight amendments to more clearly distinguish the presently claimed invention from Bakker.

Claims 1, 12, 23 and 24 have been amended to more clearly indicate that the presently claimed invention is directed to a gas cluster ion beam (GCIB) processing apparatus that includes mass or cluster size diagnostics for improving GCIB workpiece processing. Bakker's apparatus is an analytical instrument, not a processing tool. Each of the rejected claims includes either "*workpiece holding means*" or "*workpiece processing*" limitations. As Bakker is directed to an analytical instrument, it teaches no such holder or processing. Rather, Bakker describes a time-of-flight mass spectrometer².

With respect to claim 1, Bakker also fails to teach either a GCIB or a GCIB source, a beam gate and beam gating signals for controllably interrupting and restoring the GCIB, and using output information to control the workpiece processing.

Paragraph 1 of the Action asserts that Bakker teaches a vacuum vessel, suggesting that element 5 of Figure 1 is a vacuum vessel. Bakker's "collector" is not well-defined, described as incorporating an electron multiplier tube³ having a cathode 23⁴, but not a vacuum or vacuum chamber. Neither Figure 1 nor any other of the figures illustrate any vacuum pumps, valves, or other components normally associated with a vacuum system, and Applicants could find no such written description in the reference.

¹ U.S. Patent No. 3,634,683 issued January 11, 1972, to Bakker, Johannes M.B.

² Bakker, col. 1, ll. 1-16

³ Bakker, col. 1, ll. 12-14

⁴ Bakker, col. 3, line 17

Bakker also fails to teach a GCIB source. Bakker's source comprises a Nier ion source that forms "molecular ions... derived from the molecules of the original sample."⁵ This is in contrast to the GCIB of the presently claimed invention, which uses a nozzle with a high pressure differential across it to form a supersonic jet that expands and cools to form "clusters, each consisting of from a few to several thousand weakly bound molecules" that are subsequently ionized to form gas cluster ions.⁶

The Action asserts that Bakker teaches a beam gate for controlling and restoring the gas cluster ion beam in Fig. 2, element S1.⁷ S1 comprises a biased electrode between the two pair of scan plates, Y-plates 21 and X-plates 22 and is described by Bakker as "a geometry control electrode".⁸ Element S1's function is to focus the ion beam and/or shape the electric fields of the two sets of scan plate pairs so that they do not interact. The biasing of S1 is created by a voltage divider across a fixed voltage power supply and thus does not vary controllably in such way as it could constitute a beam gate for interrupting the beam as recited in claim 1. Bakker never discusses or suggests a "beam gate" or "gating the beam" or "interrupting and restoring the beam". Indeed, Bakker's ion beam is continuous.⁹ The presently claimed invention recites a beam that is completely interrupted and restored by the beam gate, not deflected from one trajectory in the vicinity of a target (i.e., collector slit 4 and collector 5) to another in continuous operation as in Bakker. Bakker's beam pair of scan plates (as shown in Fig. 2) deflect the beam stepwise from one trajectory to another, but the beam is never interrupted nor restored.

In light of the foregoing, Applicants respectfully assert that claim 1, as amended, as well as those rejected claims (2-3, 6, 9-11) and objected to claims (4-5, 7-8) that depend from claim 1, are thus similarly patentable over Bakker.

⁵ Bakker, col. 2, line 64 thru col. 3, line 5

⁶ Applicants' specification, paragraphs 36-37

⁷ Please note, element S1 does not appear in Fig. 2, but rather in Fig. 1.

⁸ Bakker, col. 3, line 6

⁹ See Col. 2, lines 28-30, and Claim 1, "...means for substantially continuously generating a beam of ions and accelerating such beam in the direction of a target...".

With respect to claim 12, as amended, Bakker first fails to teach or suggest the GCIB, GCIB source, workpiece processing and workpiece holding means that are discussed above with respect to claim 1.

Bakker additionally fails to teach or suggest, as recited in claim 12, "*...a beam deflector for controllably interrupting and restoring the gas cluster ion beam flow along the first trajectory by deflecting the gas cluster ion beam along a second trajectory...*" where said first trajectory terminates upon a "*beam current measurement means*." Nor does Bakker teach using output information from the time-of-flight analyzer in controlling the workpiece processing.

The presently claimed invention, as recited in claim 12, employs a deflector to controllably switch the beam between two trajectories - either along the first trajectory terminating in the beam current measuring means, or out of the beam current measuring means along the second trajectory. In contrast, Bakker has a deflector that, using step function excitation¹⁰, switches his beam between two trajectories¹¹, neither of which *terminate* in a beam current measuring device. Rather, during the beam switching transient, the beam sweeps *across* collector slit 4 and/or collector 5 and the short resulting current transient is measured and analyzed. There is a resulting "periodic effect on the collector"¹² from the beam transiting the current collector.

In light of the foregoing, Applicants respectfully assert that claim 12, as amended, as well as those rejected claims (13-15, 18, 21-22) and objected to claims (16-17, 19-20) that depend from claim 12, are thus similarly patentable over Bakker.

The foregoing arguments made with respect to claim 1, as amended, related to Bakker's failure to teach or suggest workpiece processing, GCIB and GCIB sources, beam gating and control signals thereof for controllably *interrupting and restoring the GCIB* are relevant to the patentability of claim 23, as amended. Applicants, thus, respectfully assert that claim 23, as amended, is patentable over Bakker.

¹⁰ Bakker, col. 1, ll. 20-22

¹¹ Indicated respectively as a0,a1,a2,a'0,a'1,a'2 and e0,e1,e2,e'0,e'1,e'2 in his Fig. 2 and described in Col 3, lines 45-56

¹² Bakker, col. 1, ll. 45-50

The foregoing arguments made with respect to claim 12, as amended, related to Bakker's failure to teach or suggest workpiece processing, GCIB and GCIB sources, and controlled deflection between two trajectories, one of which terminates upon a beam current measurement means are relevant to the patentability of claim 24, as amended. Applicants, thus, respectfully assert that claim 24, as amended, is patentable over Bakker.

With respect to claim 25, the claim has been amended to include the "*taking a derivative of the current transient after time t_0* " limitation from allowable claim 32. As this step is not taught or suggested by Bakker, Applicants respectfully submit that claim 25, as amended, as well as those rejected claims (26-31, 33-35) and objected to claim 32, as amended, that depend from claim 25 are patentable over Bakker.

For at least the above noted reasons, Applicants respectfully submit that claims 1-35 are in a condition for allowance, and respectfully requests that the Examiner reconsider and withdraw all outstanding rejections and objections. Favorable consideration and allowance are earnestly solicited. Should there be any questions after reviewing this paper, please call Applicant's attorney at 617-854-4000.

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